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Smoke Pollution of the Atmosphere in the Potteries.

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DR. OWENS, Secretary to the Committee for the Investigation of Atmospheric Pollution, in a paper read at the Congress of the Institute, at Folkestone, referred to the pottery industry as one of two industries in which it was, probably at the present time, not possible to prevent the emission of smoke and carry on the industry successfully.

The complaint of pollution of the atmosphere by smoke in the potteries has gradually become more insistent. There is no doubt the County Borough is particularly unfortunate, because not only does the pollution arise directly from the manufacture of pottery, the staple industry, but it is also associated with the manufacture of the Staffordshire Blue Brick especially. Further, the amount of refuse resulting from the staple industry is very large, and has to be tipped in various hollows throughout the area. Sooner or later these are set on fire and produce a large amount of smoke. (At times there may be as many as six or eight alight.) There is also, in addition, a number of coal mines and ironstone mines, with the calcining of ironstone heaps. These are, of course, additional to the domestic fires, road engines, boilers, turnaces, etc.

It is estimated that there are some 2,500 ovens and kilns, and 500-600 boiler stacks in the district, and to each oven and kiln there might be on an average six or eight fireplaces. An oven of an average size might consume as much as 12 tons of coal at each firing, once or twice a week. A very large amount of coal is thus used, apart from that used by steam-raising plants.

The ovens in use are usually the bottle-shaped ones.

In a general way the construction of these ovens is shortly, as follows :—

- (1.) The hovel with chimney rising to a height of from 30 to 60 feet.
- (2.) The oven proper within the hovel, say 15 feet in diameter, and 15 feet to the shoulder with eight or ten furnaces in the circumference.
- (3.) Several openings on the crown for ventilation, to be opened and shut as required.
- (4.) The mouth for filling the oven.

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When filled with articles to be fired with their containers, the oven might contain as much as 20, 30 or even 40 tons of material, much of it in only partially dried condition, so that there might be as much as two, three or four tons of water to be driven off in the firing.

In the first stage of firing or heating the aim is to dry the contents of the oven by slowly raising the temperature up to from 100°C. to 150°C. In the second stage, among other changes, the combined water has to be got rid of at a temperature of about a dull red heat, say 600°C. to 800°C. , and finally the temperature must be further raised to about $1,200^{\circ}\text{C.}$, so as to produce more or less fusion or vitrification, continued at this temperature, and then allowed to cool.

In firing this type of oven, much, if not everything, depends on the practical knowledge of the fireman, his experience generally, as well as of that particular oven: the idiosyncrasy of every oven must be learnt. The fireman must be able to draw correct conclusions from his test pieces, and from glimpses into the oven: he must be able to heat one section of his oven and keep back another section; to know when to ventilate the oven and when to check ventilation; he must not dry the ware too quickly, or else it will crack; he must even be able to draw correct conclusions from the smoke emitted. If small coal and slack be used, instead of a better coal, greater care is necessary. He must not fire the oven at too high a temperature; he has eight or ten fireplaces to attend to; his task is an exacting one. His aim is to produce good ware; it is not his object to fire his oven without emitting smoke.

In the firing of the glost ovens, *i.e.*, the ovens in which the glazing of the ware is carried out, many difficulties similar to those met with in firing biscuit ovens are encountered, though the process can be carried out more quickly at a somewhat lower temperature; and the same may be said of enamelling kilns.

From continuous observations it has been found that in biscuit ovens, *in one case* the period of firing lasted 75 hours, and during that time black and moderate smoke was emitted for 27 hours. *In a second case*, the firing lasted $52\frac{1}{2}$ hours, and black and moderate smoke was emitted during 18 hours. During the first hours of drying a considerable amount of steam is mixed with the smoke.

In the case of glost ovens, in one fired for nearly 22 hours there were eight hours of black and moderate smoke, in a second case, fired for 33 hours, there were 12 hours black and moderate smoke.

In the case of one kiln, black and moderate smoke was emitted for $5\frac{1}{2}$ out of ten hours, and in a second case $6\frac{1}{2}$ out of $8\frac{3}{4}$ hours.

Another special difficulty in this district is that in connection with the

manufacture of the Staffordshire Blue Bricks, tiles, etc. In order to produce a marketable brick, it is necessary, at a certain stage of firing, to have in the kilns a reducing atmosphere, in order to reduce the red oxide of iron, and produce the blue colour, as well as to perfect the brick. This reducing atmosphere is ensured by cutting off the air supply, and as a result a large amount of smoke is emitted. The duration of firing the kiln might be about seven days, and the air is excluded for the last 30 hours or so.

At 12 noon on the 16th of last month (September), observations were made through the County Borough (care was taken to avoid overlapping) and it was found that 125 stacks were emitting black smoke, and 107 moderate smoke.

With respect to steam raising plants in the County Borough, when there is one boiler to a stack, three minutes black smoke in the half hour is permitted ; in the case of two boilers 4 minutes ; and in the case of three or more five minutes in the half hour. It is admitted that with proper construction and careful firing, no black smoke, and practically no smoke of any kind should be emitted from a boiler stack. Overworking, an effort to produce an impossible amount of steam, is a common cause of black and moderate smoke emission. Few manufacturers seem to know the capabilities of their plant.

I think that in this district it is probably felt that the amount of smoke from the pottery ovens and kilns is so great as to overwhelm the other agents of smoke pollution, and so little effort is made to reduce the smoke. The heights of the boiler chimneys vary from 80 feet to close on 150 feet, and consequently the nuisance is less keenly felt than in the case of pottery ovens, from which the volume of smoke emitted is large, and is poured from the low chimneys into the streets, offices and dwelling houses. These low chimneys cannot be raised. As you pass through the district it will be noticed that houses are, to a very large measure, built right up to the boundary walls of the factories.

There can be no disputing the fact that there is a serious pollution of the atmosphere by smoke in this area. I regret that there are no instruments for recording the exact amount of pollution, but I am hoping that this will be remedied at an early date.

The Borough is fortunate in that *it is a long narrow district* ; at few points is it even two miles wide from east to west. The atmosphere is thus readily cleared of smoke by slight winds.

There is in the County Borough a somewhat *Excessive Death Rate* from pneumonia and bronchitis (*acute lung diseases*), and it is not, I think, unreasonable to attribute some of this excess to deficiency of sunlight and fogs. Various authorities have, from time to time, put forward statistics which

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show a direct relation between fogs and smoke in large industrial towns and a rise in the death rate from acute lung diseases. In this connection I would mention Dr. Niven, Medical Officer of Health for Manchester, the Medical Officer of Health for Glasgow and Mr. Bailie Smith, of Glasgow. There are many others.

I have not been able, through lack of observations, to bring forward any such statistics in connection with Stoke-on-Trent. I thought, however, it might prove interesting to know what, if any, conclusions had been come to by the authorities of Pittsburg, Pennsylvania, U.S.A., where a very large experiment is in progress.

I have a communication from the Director of the Department of Public Health of that city, where smoke laws have been in force since 1913, and where the atmospheric conditions have been consequently entirely altered. He states that "the reduction of the amount of smoke thrown out into the atmosphere is believed to be at least 75 per cent., and the city is a better place to live in from the point of view of comfort and appearance; that the average death rate per 10,000 of the population from bronchitis has been reduced from 3.95 to 2.89; that from Phthisis shows a very slight increase, and that from pneumonia an increase from 25.34 to 38.75. He adds that a puzzling peculiarity about the records is that the disease which shows a decrease has shown a decreased rate since 1873, and those that show an increase have also shown an increasing rate since 1873. The Director states that those specially engaged in consideration of the matter have an impression that the increase in deaths from pneumonia is principally due to sudden climatic changes, and to the effect of street dust, and also to the under ventilation of public buildings and the houses of the people."

In the case of pottery ovens and kilns, even in the worst type, it is found that *with care in firing*, much improvement is possible; works when known to be under observation emit less smoke from their ovens than at other times. Close supervision will bring about improvement lasting for months, and that without unduly harassing the fireman or causing injury to the goods fired. Certain types of the bottle shaped ovens (called down draught ovens) are thought to be more efficient from the point of view of smoke prevention, and some manufacturers are of the opinion that the next step taken should be towards the elimination of all the older types of ovens.

For years past the question of firing ovens and kilns with gas has attracted much attention, and one even hopes that some method may be devised whereby gas produced in sufficient quantity, of right quality, and at a low enough price, might be applied to the ordinary bottle-shaped ovens and kilns, or some slight modification thereof. Though that has not yet been attained to, definite progress has been made, and at present there are in this district

several specially constructed efficient ovens and kilns fired by producer gas, I have heard it maintained in all seriousness that sooner or later these newest methods will have to be adopted generally from the point of economy in use.

There are two chief forms of these ovens or kilns in use in the district at the present time, one is the tunnel oven (Dressler or other form) and the other the Shaw oven. In the case of the tunnel oven, a tunnel is constructed of brick and firebrick. It varies in length from 120 feet to 300 feet. A certain portion of this tunnel, somewhat nearer the exit than the entrance, is heated to the required temperature by producer gas from a special plant. The gas is drawn to the oven by a fan, and cold air is drawn in through the exit end of the tunnel. The goods to be fired are very slowly drawn into the tunnel from the entrance on low trolleys running on rails. The goods thus pass from the entrance through a gradually rising temperature, ultimately passing out through the cooler portion of the tunnel, and at the exit they are cool enough to be dealt with.

In the case of the *Shaw oven*, there is a rectangular structure of brick and firebrick, 60 feet by 100 feet, containing 16 chambers or ovens. Producer gas from a special plant can be passed into any of these chambers, the first chamber is heated gradually to the required temperature for the necessary length of time, the waste heat passing to the succeeding chambers towards the chimney, gradually raising the temperature of the chambers. When the goods in the first chamber are sufficiently fired, the gas is turned into the second chamber, and the first begins to cool ; and so on until the last is fired, and the first and others unpacked.

In the tunnel oven the goods are moved on into and through the heat, and in the Shaw oven the heat is moved from chamber to chamber while the goods are stationary.

These gas fired ovens and kilns are now established on a firm basis in the district, and they solve the problem of firing without the emission of smoke. There are, however, various difficulties in the way of their general adoption, and the following are some of those which have been put to me :—

- (1) It is not yet sufficiently proved by practical experience that these ovens and kilns can be used for all kinds of ware, and for all purposes.
- (2) The first cost of these ovens and kilns is prohibitive to many manufacturers.
- (3) The space required is so great that they can only be erected under present circumstances in a comparatively few factories. In many instances the factories are so surrounded by dwelling houses that these must be demolished before developments can take place ; and
- (4) For smaller firms these ovens are too large to allow economical working.